BUNDESREPUBLIK DEUTSCHLAND

DEUTSCHES PATENT- UND MARKENAMT

(12) Laid Open Publication

(10) DE 199 63 580 A1

(51) Int.Cl7:
F 16 F 9/53
B 60 G 13/02
F 16 F 9/50
B 60 R 22/28

(21) Application number: 199 63 580.3
(22) Date of filing: 29. 12. 1999
(43) Date of publication: 9. 8. 2001

DE 199 63 580 A 1

(71) Applicant:
Autoliv Development AB, Vargada, SE

(74) Representative:
Becker und Kollegen, 40878 Ratingen

72) Inventor:
Meyer, Berhnhard, 80993 München, DE

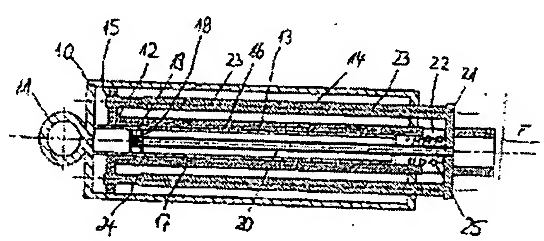
(56) Citations:

DE	195 23 966 C2
DE	197 17 693 A1
DE	41 34 354 A1
DE	39 05 639 A1
DE	10 30 625 B
US	52 84 330

The following information is based on the documents filed by the applicant

(54) Controllable Power Limitation Element

(57) A power limitation element in the form of a damping device, particularly as component of a safety system in motor vehicles, with a storage chamber filled with a rheological fluid (ERF/MRF) and with a piston moved through the storage chamber when the power to be limited is introduced, wherein an electric field or respectively magnet field of controllable strength can be produced for adjusting the viscosity of the rheological fluid and thereby the energy consumption when the piston moves through the storage chamber, characterized in that the assembly consisting of the storage chamber (20, 27, 41) filled with the rheological fluid and the piston (18, 32, 42) as control assembly is interconnected with a further damping element (10, 12; 10, 26; 35, 36) such that the position of the piston (18, 32, 42) as control piston in the storage chamber (20, 27, 41) filled with the rheological fluid, determines the energy consumption of the damping element (10, 12; 10, 26; 35, 36) and the power to be limited is applied to the damping element (10, 12; 10, 26; 35, 36).



DE 199 63 580 A 1

translated from German, 2006/05/23

Controllable power limitation element

The invention regards a Power limitation element in form of a damping device, particularly as component of a safety system in motor vehicles with a storage chamber filled with a rheological fluid (ERF/MRF) and with a piston moved through the storage chamber when the power to be limited is introduced, wherein an electric field or respectively magnet field of controllable strength can be produced for adjusting the viscosity of the rheological fluid and thereby the energy consumption when the piston moves through the storage chamber.

A power limitation element thus designed without concrete reference to its use is described in US 5 284 330. A modification of the magnet field acting on the, in that case, magneto-rheological fluid (MRF) leads to a modification of the viscosity of the fluid used, so that the coordinated piston can be moved through the storage chamber designed in form of a cylindrical housing dependant on the set viscosity with corresponding energy consumption and thereby limitation of the power applied to it. As far as the energy consumption of the power limitation element depends on the dimensions of storage chamber and piston as well as on the respectively set strength of the magnetic field, a creation of a correspondingly strong magnetic field by means of a correspondingly set current is necessary, in addition to a corresponding assembly size for an important power limitation. In this respect, the known power limitation element has the disadvantage that the necessary assembly of components for the power limitation and for the supply with correspondingly strong magnetic fields in the assembly size is complicated and correspondingly expensive in its operation. Alternatively, electro-rheological fluids (ERF) are used for such power limitation elements, the viscosity of which can be controlled by means of an electric field.

If such a power limitation element is to be used as component of safety systems in motor vehicles, it is requested that, starting from a high energy consumption set at the beginning of the power limitation, the

progression of the energy consumption is to be controlled such that a low energy consumption is achieved, thus the power limitation should progress from a hard damping towards a softer damping and then, if necessary, to a harder damping again, if the predicted accident is avoided.

Therefore, it is the objective of the invention to provide a power limitation element with the type-conform features which provides a controllable power limitation with distinctly reduced efforts in production and operation. This objective is solved by the content of the claims following this description, including advantageous embodiments and further developments of the invention.

The invention basically suggest that the assembly composed of the storage room filled with the rheological fluid and the piston as a control assembly is interconnected with a further damping element such that the position of the piston as control piston in the storage room filled with rheological fluid determines the energy consumption of the damping element and the power to be limited applies to the damping element. The invention has the advantage that the assembly supplied with an electric field or respectively magnetic field is used for a damping element responsible for the major part of the power limitation, so that correspondingly small assembly sizes and low power supply are required for the design of the control assembly operating on the basis of a rheological fluid.

When, according to one embodiment of the invention, it is provided that the control assembly and the damping element are interconnected such that the damping element has the maximum energy consumption when the control assembly is without current, a further substantial advantage is ensured, namely that the damping element provides the highest energy consumption when the control assembly is without current, so that even in cases of a drop out of the control assembly a sufficient power limitation is guaranteed.

In a first embodiment of the invention, the further damping element is designed as fluid damper with a damping piston that is moved

through a viscous fluid when power is applied, wherein the power to be limited is applied to the damping piston and the control piston of the control assembly is coupled to the damping piston. Thereby, the viscous fluid can consist amongst others of an adequate oil or a silicone; further fluids with adequate viscosity are comprised in the invention.

Therefore, it can be provided that the damping piston is moved through the viscous fluid present in a closed chamber when the power to be limited is applied and that it has a fluid transfer path for a transfer of the viscous fluid from the part of the chamber on which pressure is exerted when the damping piston is moved forward to the part of the chamber generated in the back of the movement of the damping piston, wherein according to one exemplary embodiment of the invention the free diameter of the fluid transfer path situated in the damping piston can be adjusted by a control element, the position of which is determined by the control piston.

A constructive embodiment of the invention provides that the damping element has a cylinder filled with the viscous fluid and that the damping piston which has at least one opening as fluid transfer path can be translationally moved through the cylinder chamber and that a cylindrically designed storage chamber filled with the rheological fluid is arranged inside the cylinder of the damping element and the control piston reaches into the opening of the damping piston and the control shaft in its area reaching into the opening of the damping piston has a section with a diameter constantly changing according to the engagement area.

For the adjustment of the control of the energy consumption of the damping element it is provided that the damping piston, opposed to the control piston with the control shaft, can be relatively moved and the control piston with the control shaft and the damping piston are coupled to each other by means of a spring.

Regarding the setting of the energy consumption it can be provided that a plurality of openings is spread over the circumference of the damping piston and coordinated thereto a plurality of control shafts connected to the control piston are provided.

In an alternative construction it is provided, according to one embodiment of the invention, that the damping element has a cylinder filled with the viscous fluid and that the cylinder chamber passed by the damping piston is separated by a separating wall and that the damping piston forms a hollow chamber surrounding its center axis and arranged concentrically to the cylinder as the storage chamber filled with the rheological fluid in which the control piston rotatorily moveable around the center axis impacts a slide arranged longitudinally shiftable in a radially running bar of the damping piston for the adjustment of the free diameter of the opening disposed in the damping piston.

According to one embodiment of the invention it is provided that, alternatively to the damping element designed as fluid damper, the further damping element is composed of a shaft provided with an external thread, which can be turned when the power to be limited is applied and a nut turnably arranged thereon with a coordinated internal thread, as well as a spring-loaded friction disk as friction resistance for the turning of the nut and that the control piston of the control assembly which is arranged in a housing shared with the damping element determines the power applied by the springs loading the friction disk.

Thereby, for setting the energy consumption of the damping element it is provided that a cylinder for the reception of the rheological fluid is longitudinally shiftable arranged in the housing as component of the control assembly on the exterior side of the nut when the nut is turned and the moveable control piston in the cylinder is leaned against a plate moveably arranged between the springs and the friction disk by means of a piston rod attached to it.

Regarding the setting of the energy consumption, it might be provided that on the exterior gearing of the nut is arranged a plurality of cylinders with corresponding control pistons and piston rods leaning against the plate.

In one exemplary embodiment for the use of a damping element according to the invention in a safety system in motor vehicles, the invention is constructed for a safety belt retractor

as such safety system, wherein the belt winding shaft is connected to the shaft and the nut is fixedly arranged on the shaft. Since thus the turning of the belt winding shaft in belt extraction direction is directly converted into a turning movement of the nut, the turning of the belt winding shaft in the belt extraction direction is damped in the same way as the turning of the nut. According to exemplary embodiments of the invention, the damping element thereby can be flanged on the belt winding shaft laterally to the housing of the safety belt retractor or the belt winding shaft can be designed with a hollow interior and the damping element is integrated in the belt winding shaft and adequately connected thereto.

The drawings display exemplary embodiments of the invention which are described in the following. They show:

fig. 1 a power limitation element with a translationally operating fluid damper as damping element in a cross-sectional view with high energy consumption

fig. 2 the object of fig. 1 with low energy consumption

fig. 3 a power limitation element with a rotatorily operating fluid damper as damping element with high energy consumption in a cross sectional view

fig. 4 the object of fig.3 with low energy consumption

fig. 5 a different exemplary embodiment of the power limitation element in a starting position in section

fig. 6 the object of fig.5 with high energy consumption

fig. 7 the object of fig.5 with low energy consumption

fig. 8 a safety belt retractor with a flanged on damping element corresponding to the exemplary embodiment according to figures 5 to7

The power limitation element illustrated in figures 1 and 2 is a translationally operating power limitation element in the form of a fluid damper which is controlled by the control assembly operating with a magneto-rheological fluid.

In detail, the damping element consists of a cylinder 10 with a terminal lug 11 for the fastening of the power limitation element, wherein a damping piston 12 is situated in the

cylinder 10, the piston rod 13 of which reaches out of the cylinder 10 such that the power to be limited is applied to the piston rod 13. The cylinder chamber 14 passed by the piston 12 is filled with a viscous fluid, for example an adequate oil or a silicone. Due to the pull-out movement of the piston rod 13 out of the cylinder 10 caused by the power application and the thus provoked movement of the damping piston 12 through the cylinder chamber 14, the viscous fluid can flow through the openings 15 present on the piston 12; the free diameter of the openings 15 thereby sets the energy consumption and thereby the damping effect when the piston shaft 13 is pulled out of the cylinder 10.

Damping piston 12 and piston rod 13 have a longitudinal bore hole 16 which receives an inner cylinder 17 attached to the cylinder 10 such that the damping piston 12 and the piston rod 13 are guided on the inner cylinder 17. In the inner cylinder 17 a control piston 18 provided with a coil 19 for the creation of a magnetic field is shiftably guided. The cylinder chamber 20 of the inner cylinder 10 serves as storage room for a magneto-rheological fluid, the viscosity of which can be modified by adjusting the magnetic field generated by the coil 19 in the surroundings of the coil.

The control piston 18 with a coordinated piston rod reaches out of the inner cylinder 17 as well as of the cylinder 10 and carries a piston plate 21 there, with holes 22 penetrated by the piston rod 13 of the damping piston 12 so that control shafts 23 emanating from the piston plate 21 are guided back into the cylinder chamber 14 of the cylinder 10 and there reach into the openings 15 in the damping piston 12. The axial dimension of the holes 22 in longitudinal direction of the piston rod 13 is selected such that a relative shifting between the damping piston 12 and the piston plate 21, the respective position of which is set by the control piston 18, is rendered possible. A spring 25 sustaining itself between the piston plate 21 and the piston rod 13 preloads the control piston 18 in the position setting a hard damping, as shown in fig. 1. The extension of this relative shifting is reflected in the fact that the control shafts 23 in their end section, interacting with the openings 15 of the piston 12, have a section with continuously changing diameter in form of an indentation 24 with a

continuous control edge, such that when a corresponding relative shifting of the control piston 18 in direction of the damping piston 12 is carried out, the sections 24 of the control shafts 23, enter in the openings 15 of the damping piston 12 and there control the free diameter for the transfer of the viscous fluid present in the cylinder chamber 14 when the damping piston 12 is longitudinally shifted in the cylinder 10.

In the starting position for the power application shown in fig.1 a high energy consumption with correspondingly hard damping of the power applied is given, since the control shafts 23 cover the openings 15 of the damping piston 12 such that only a small free diameter of the openings 15 can be used for the transfer of the viscous fluid when the damping piston 12 is at disposal in the cylinder 10. If no magnetic field is active while the damping piston 12 is moved in the cylinder chamber 20, more precisely in the area of the piston 18, the control piston 18 follows the movement of the damping piston 12 because of its coupling to the piston rod 23 [should read 13] by means of the spring 25 and no relative movement between the control shafts 23 and the damping piston 12 is carried out. Thus the position of the components to each other which causes the hard damping as shown in fig.1 remains unchanged.

If the damping is to be changed such that a softer damping characteristic is provided, the magneto-rheological fluid present in the cylinder chamber 20 in the area of the piston 18 is charged with a magnetic fluid of corresponding size and thus the viscosity is locally increased. If now, when the piston 18 is shifted, the fluid either passes through openings (not shown) situated in the piston or through the ring-shaped gap between the piston cylinder surface and the inner cylinder 17, this is only possible with a significantly increased flow resistance. Thus the movement of the control piston 18 and the control shaft 23 coupled thereto is smaller compared to the movement of the damping piston 12 so that a relative movement of the damping piston 12 opposed to the control shafts 23 leading to of the spring 25 being loaded, is carried out, which results in the control shaft 23 with its section 24 reaching into

the opening 15 of the damping piston 12. Because of the indentation in this position, the free diameter of the opening 15 is enlarged and the resistance against the viscous fluid flowing through the openings 15 is lowered and the energy consumption is reduced. At the end of the setting process the spring 25 removes the control piston 18 into its initial position.

The damping characteristic of the system can thus be individually set, due to the setting of the force of the spring 25 and the design of the section 24 forming control edges of the control shaft 23 in connection with the creation of a magnetic field of corresponding strength for the adjustment of the movement of the control piston.

Regarding the exemplary embodiment of fig. 3 and 4, the conditions are comparable to those of the exemplary embodiment described in figures 1 and 2, since the damping element is again a cylinder 10 filled with a viscous fluid. The coordinated damping piston 26, however, this time is moved rotatorily in the cylinder chamber 14, so that the power to be damped is applied to the damping piston 26 in the direction of its rotation. The damping piston 26 consists of a wall 50 surrounding its center axis 28 like a ring, forming a hollow chamber 27 as storage chamber for the magneto-rheological fluid and of a bar-like area 29 reaching to the inner wall of the cylinder 10. The thus formed ring chamber 51 of the cylinder chamber is separated by a separating wall 30 in order to allow a defined resistance of the viscous fluid present in the ring chamber 51 against the turning movement of the damping piston 26 or respectively its bar 29. The bar 29 of the damping piston 26 has an opening 31 for the transfer of the viscous fluid as described, wherein a slide 34 for the adjustment of the free diameter of the opening 31 in the damping piston 26 is arranged in the bar 29 such that it can be radially shifted. The slide 34 has a opening 52 with a corresponding control edge which can overlap the opening 31 of the bar 29 of the damping piston 26 so that the free diameter of the opening 31 is set by the position of the slide 34. The slide 34 is preloaded by a spring 53 so that it is placed in the position according to fig. 3, in which it covers the opening 31.

The slide 34 reaches into the hollow chamber 27 filled with the magneto-rheological fluid and is controlled there by a control piston 32 which can rotate around the center axis 28 and is also a rotatorily operation piston, like the damping piston 26. In the hollow chamber 27 filled with the magneto-rheological fluid a separating wall with a fluid transfer opening and a coil 33 for the creation of the required magnetic field is situated.

As basically displayed in the description of the exemplary embodiment according to figures 1 and 2, in the starting position shown in fig. 3 a hard damping characteristic is also provided, since the opening 31 in the bar 29 of the damping piston 12 is covered by the slide 34. If no field is created by the coil 33 in the hollow chamber 27 in the area of the separating wall and if thus the viscosity of the overflowing magneto-rheological fluid is low, when the damping piston 26 rotates around its center axis 28 the slide 34 also turns the control piston 32, so that the slide 34 remains in the position shown in fig. 1. If for the setting of the damping characteristic a magnetic field is created by the coil 33 and the viscosity of the magneto-rheological fluid is thus locally increased, the rotating movement of the control piston 32 meets a resistance which leads to the slide 34 being radially shifted in the operation area formed on the control piston until its opening 52 and the opening 31 in the damping piston 26 overlap, a position which results in a lowered energy consumption and therefore in a softer damping effect.

In figures 5 to 7 one exemplary embodiment of the invention is illustrated which has a damping element designed as mechanically operating damper. The power to be damped, acting to the left in figures 5 to 7, in this exemplary embodiment is applied to a shaft leading through a housing 37 for the reception of the damping element and the coordinated control assembly. The shaft 35 is provided with a thread having a correspondingly large thread pitch, so that the power to be limited, translationally applied to the shaft as tensile force can cause a turning moment by means of the thread. This axial movement of the shaft 35 is countervailed in order to limit the power by turnably arranging a nut 36 with coordinated inner

thread inside the housing 37 on the shaft 35. The nut 36 is like a friction coupling situated against a friction disk 38 which is integral with the housing, which is loaded by springs 40 by means of a plate 39 arranged in the housing 37, such that the friction disk 38 due to the loading by the springs 40 countervails resistance to the turning of the nut 36 resulting in a damping of the power applied at the shaft 35.

In the illustrated exemplary embodiment, two control assemblies are arranged on the exterior shell of the nut 36 to set this power limitation, operating with a magneto-rheological fluid, placed with their cylinders 41 provided with an exterior thread on an exterior thread of the nut 36 such that a turn of the nut 36 leads to a translationally movement of the cylinders 41 in the housing 37 toward the friction disk 38. In the cylinders 41 filled with the magneto-rheological fluid pistons 42 coupled to a coordinated coil are arranged, the piston rods 43 of which reach out of the cylinder 41 and abut the plate 39 such that, when the cylinder 41 is translationally moved, they shift the plate 39 dependant on their changing engagement position in the cylinder 41 against the load of the springs 40 and thus release the friction disk 38 from the effect of the springs, so that the friction disk 38 offers low resistance against the turning of the nut 36, which leads to a low energy consumption and a softer damping. If in the starting position shown in fig. 5 a power to be limited is introduced into the shaft 35, the shaft 35 tends to turn and thus also turn the nut 36; the turning of the nut 36 is inhibited by the abutting of the spring-loaded friction disk 38 until a preset power level is exceeded. Thus, initially a hard damping characteristic is set. If a nut 36 is turned when the power is exceeded, the cylinders 41 are axially shifted in the direction of the friction disk 38 without this shifting influencing the strength of the springs 40 as long as no magnetic field acts on the magneto-rheological fluid present in the cylinders 41 and the piston 42 thus is lightly pushed into the cylinder 41. Thus the hard damping characteristic is maintained.

In order to set a softer damping a magnetic field is created, whereby the magneto-rheological fluid present in the cylinders 41 offers greater resistance to the inserting movement of the pistons 42 so that, when the

cylinders 41 are axially shifted, the piston rods 43 exert pressure on the plate 39 and thus release the friction disk 38 from the acting of the springs 40. Thus the friction between the nut 36 and the friction disk 38 is reduced, which leads to a lower energy consumption.

Fig. 8 shows an exemplary embodiment for the assembly of a damping element designed according to the damping element described in fig. 5 in connection with a safety belt retractor 60 as safety system in motor vehicles, wherein the not in detail displayed belt winding shaft for the belt 62 is fixedly attached to the shaft 35 of the damping element already described regarding figures 5 to 7. In the illustrated exemplary embodiment, the damping element concerned is laterally attached to the housing 61 of the safety belt retractor 60. As not further displayed, the damping element can also be integrated within a hollow belt winding shaft.

If the damping element according to figures 5 to 7 is used for the power limitation when a belt winding shaft, blocked in a known manner by a blocking mechanism situated at the safety belt retractor, is turned in the unwinding direction of the belt 62, it is not necessary to turnably arrange the nut 36 on the shaft 35, instead, the nut 36 is to be fixedly connected to the shaft 35 so that the turning of the belt winding shaft in unwinding direction of the belt 62 is conversed into a turning of the nut 36 in the same direction. This turning movement of the nut 36 and thus the turning movement in the same direction of the belt winding shaft is damped by the assemblies displayed in figures 5 to 7, as described in detail in the text regarding the exemplary embodiment according to figures 5 to 7 of an exemplary embodiment of a damping element.

The features disclosed in the preceding description, in the claims, the abstract and the drawing disclosed features of the object of this documentation, individually as well as in optional combinations with each other, can be essential for the realization of the invention in its different embodiments.

CLAIMS

1. Power limitation element in form of a damping device, particularly as component of a safety system in motor vehicles with a storage chamber filled with a rheological fluid (ERF/MRF) and with a piston moved through the storage chamber when the power to be limited is introduced, wherein an electric field or respectively magnet field of controllable strength can be produced for adjusting the viscosity of the rheological fluid and thereby the energy consumption when the piston moves through the storage chamber, characterized in that the assembly consisting of the storage chamber (20, 27, 41) filled with the rheological fluid and the piston (18, 32, 42) as control assembly is interconnected with a further damping element (10, 12; 10, 26; 35, 36) such that the position of the piston (18, 32, 42) as control piston in the storage chamber (20, 27, 41) filled with the rheological fluid, determines the energy consumption of the damping element (10, 12; 10, 26; 35, 36) and the power to be limited is applied to the damping element (10, 12; 10, 26; 35, 36).
2. Power limitation element according to claim 1, characterized in that the control assembly and the damping element are interconnected such that the damping element has the maximum energy consumption when the control assembly is without current.
3. Power limitation element according to claim 1 or 2, characterized in that the further damping element (10, 12) is designed as fluid damper with a damping piston (12, 26) moved through a viscous fluid when power is applied and the power to be limited is applied to the damping piston (12, 26) and that the control piston (18, 32) of the control assembly is coupled to the damping piston (12, 26).
4. Power limitation element according to claim 3,

characterized in that the viscous fluid consists of an adequate oil.

5. Power limitation element according to claim 3, characterized in that the viscous fluid consists of a silicone.
6. Power limitation element according to one of the claims 3 to 5, characterized in that the damping piston (12, 26) moved through the viscous fluid present in a closed chamber (14) has a fluid transfer path (opening 15, 31) for a transfer of the viscous fluid from the part of the chamber (14) on which pressure is exerted when the damping piston (12, 26) is moved forward to the part of the chamber (14) generated in the back of the movement of the damping piston (12, 26).
7. Power limitation element according to claim 6, characterized in that the free diameter of fluid transfer path (opening 15) situated in the damping piston (12, 26) can be adjusted by a control element (23, 34) determined in its position by the control piston (18, 32).
8. Power limitation element according to one of the claims 1 to 7, characterized in that the damping element has a cylinder (10) filled with the viscous fluid and the damping piston (12) which has at least one opening (15) as fluid transfer path can be translationally moved through the cylinder chamber (14) and that a cylindrically designed storage chamber (20) filled with the rheological fluid is arranged inside the cylinder (10) of the damping element and the control piston (18) with a control shaft (23) connected thereto reaches into the opening (15) of the damping piston (12) and the control shaft (23) in its area reaching into the opening (15) of the damping piston (12) has a section (24) with a diameter constantly changing according to the engagement area.
9. Power limitation element according to claim 8 characterized in that the damping piston (12) opposed to the control piston (18) with

control shaft (23) can be relatively moved and the control piston (18) with control shaft (23) and damping piston (12) are coupled to each other by means of a spring (25).

10. Power limitation element according to claim 8 or 9, characterized in that a plurality of openings (15) is spread over the circumference of the damping piston (12) and coordinated thereto a plurality of control shafts (23) connected to the control piston (18) is provided.

11. Power limitation element according to one of the claims 1 to 7, characterized in that the damping element has a cylinder (10) filled with the viscous fluid and the damping piston (26) radially extending from a center axis (28) can be rotatorily moved through the cylinder chamber (14), wherein the cylinder chamber (14) passed by the damping piston (26) is separated by a separating wall (30) and that the damping piston (26) forms a hollow chamber (27) surrounding its center axis (28) and arranged concentrically to the cylinder (10) as the storage chamber filled with the rheological fluid in which the control piston (32) rotatorily moveable around the center axis (28) impacts a slide (34) arranged longitudinally shiftable in a radially running bar (29) of the damping piston (26) for the adjustment of the free diameter of the opening (31) disposed in the damping piston (26).

12. Power limitation element according to claim 1 or 2, characterized in that the further damping element is composed of a shaft (35) provided with an external thread, which can be turned when the power to be limited is applied and a nut (36) turnably arranged thereon with corresponding internal thread, as well as a spring-loaded friction disk (38) as friction resistance for the turning of the nut (36) and that the control piston (42) of the control assembly which is arranged in a housing (37) shared with the damping element (35, 36) determines

the power applied by the springs (40) loading the friction disk (38).

13. Power limitation element according to claim 12, characterized in that a cylinder (41) serving for the reception of the rheological fluid is longitudinally shiftable arranged in the housing (37) as component of the control assembly on the exterior side of the nut (36) when the nut (36) is turned and the moveable control piston (42) in the cylinder (41) is leaned against a plate (39) moveably arranged between the springs (40) and the friction disk (38) by means of a piston rod (43) attached to it.
14. Power limitation element according to claim 12 or 13, characterized in that on the exterior gearing of the nut (36) is arranged a plurality of cylinders (41) with corresponding control pistons (42) and piston rods (43) leaning against the plate (39).
15. Safety belt retractor with a belt winding shaft and with a damping element according to one of the claims 12 to 14, wherein the belt winding shaft is connected to the shaft (35) and the nut (36) is fixedly arranged on the shaft (35).
16. Safety belt retractor according to claim 15, wherein the damping element is flanged on the belt winding shaft laterally to the housing (61) of the safety belt retractor (60).
17. Safety belt retractor according to claim 15, wherein the damping element is integrated in the belt winding shaft which is hollowly shaped for receiving the damping element.

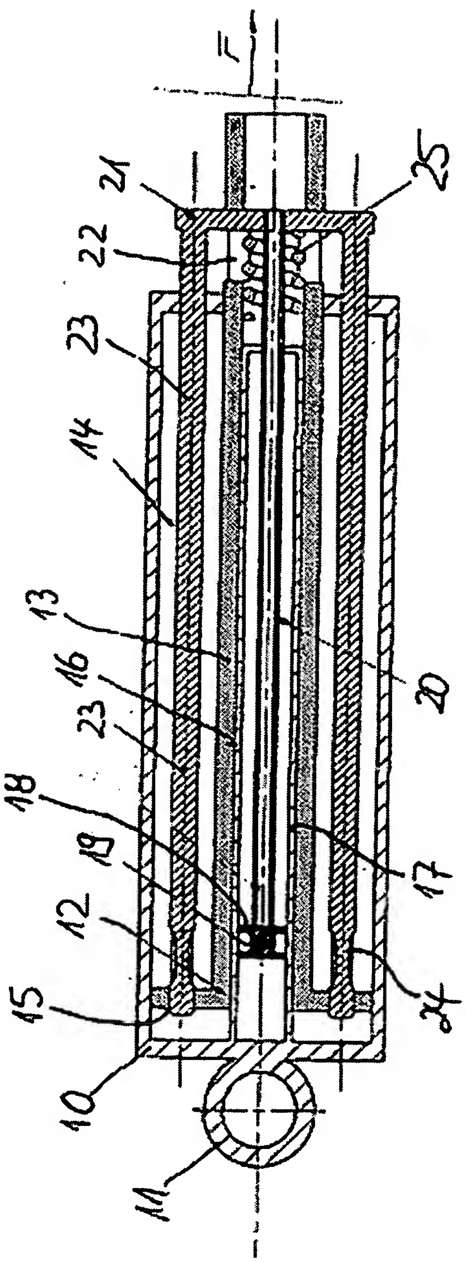

F
21
22
25
23
14
13
16
23
18
19
12
15
10
11
20
17
24

Fig. 1

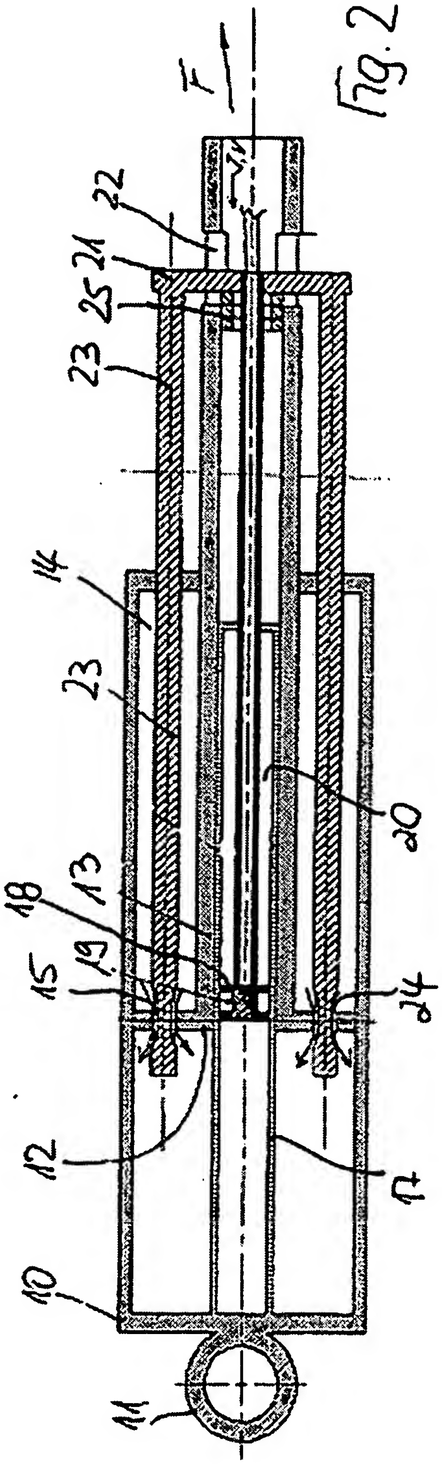

F
22
21
25
23
14
23
13
18
19
15
24
12
20
17
10
11

Fig. 2

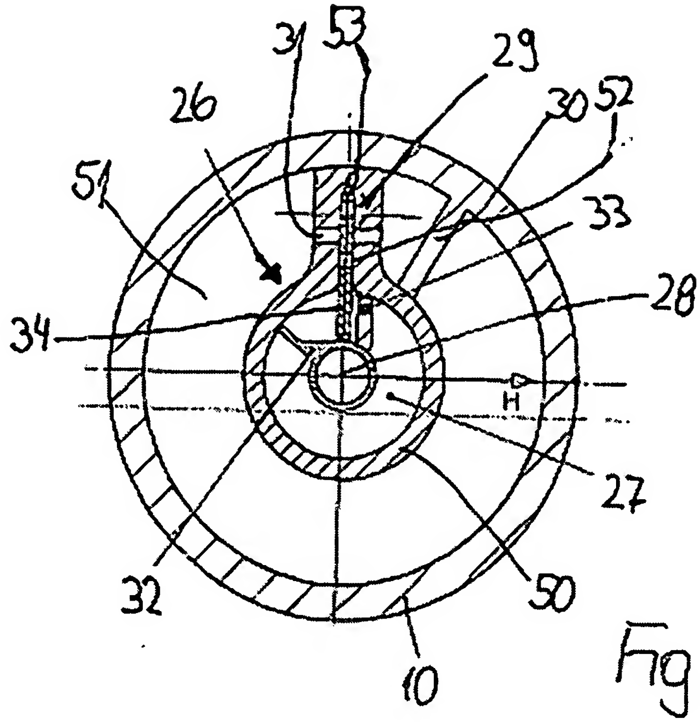

31
53
29
26
30
52
51
33
34
28
H
27
32
50
10

Fig. 3

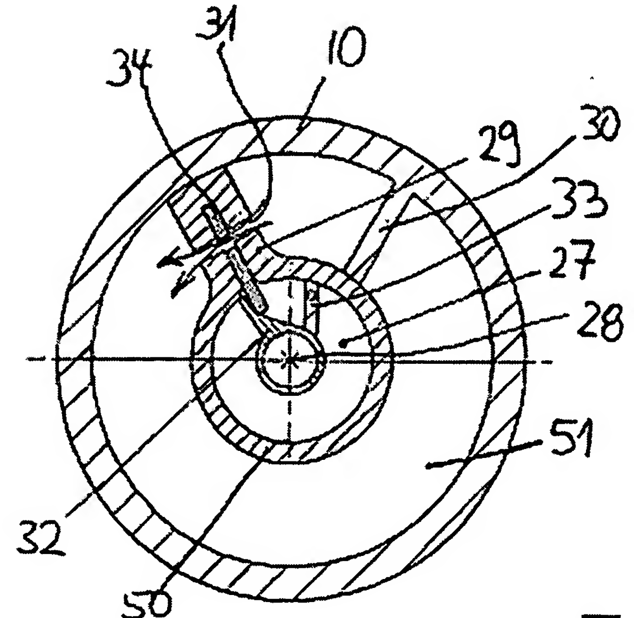

31
34
10
29
30
33
27
28
51
32
50

Fig. 4

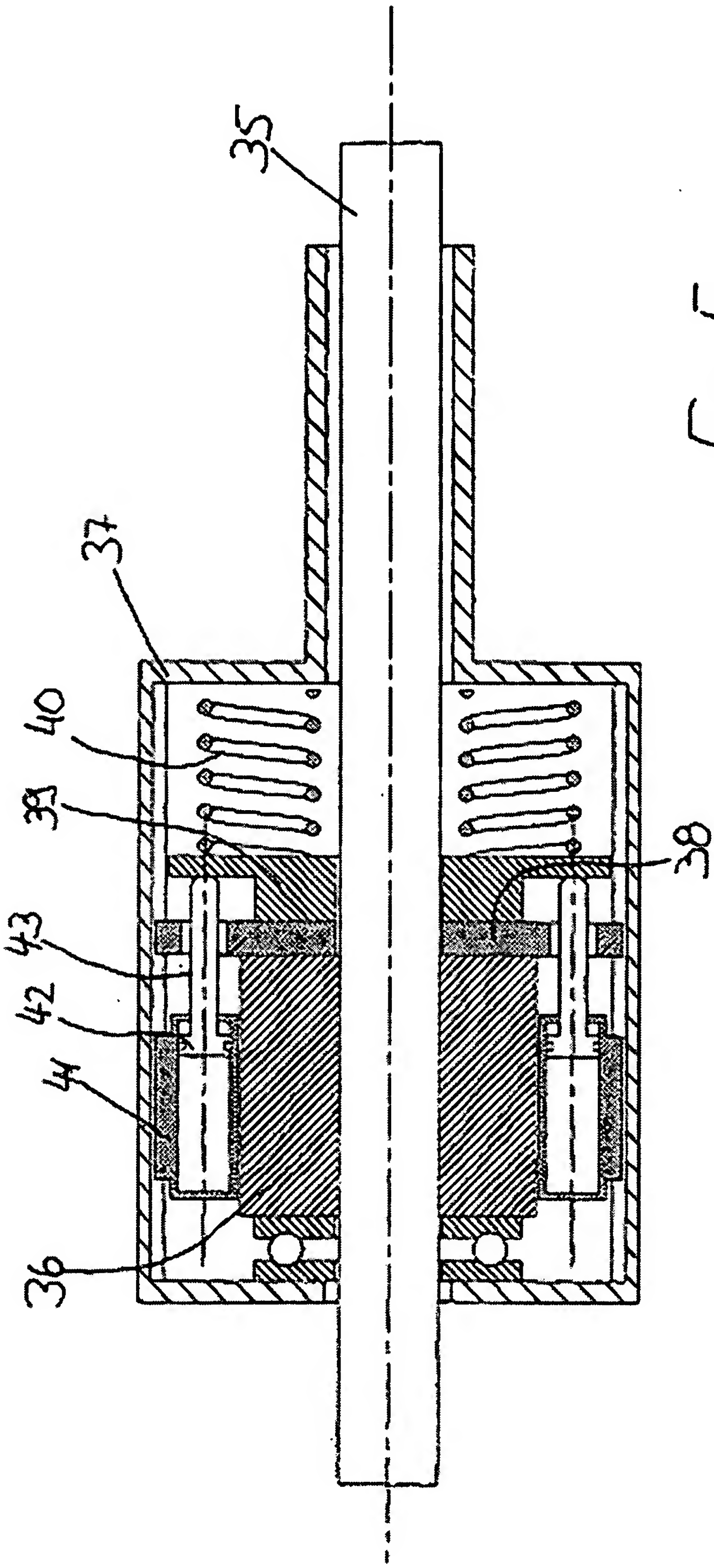
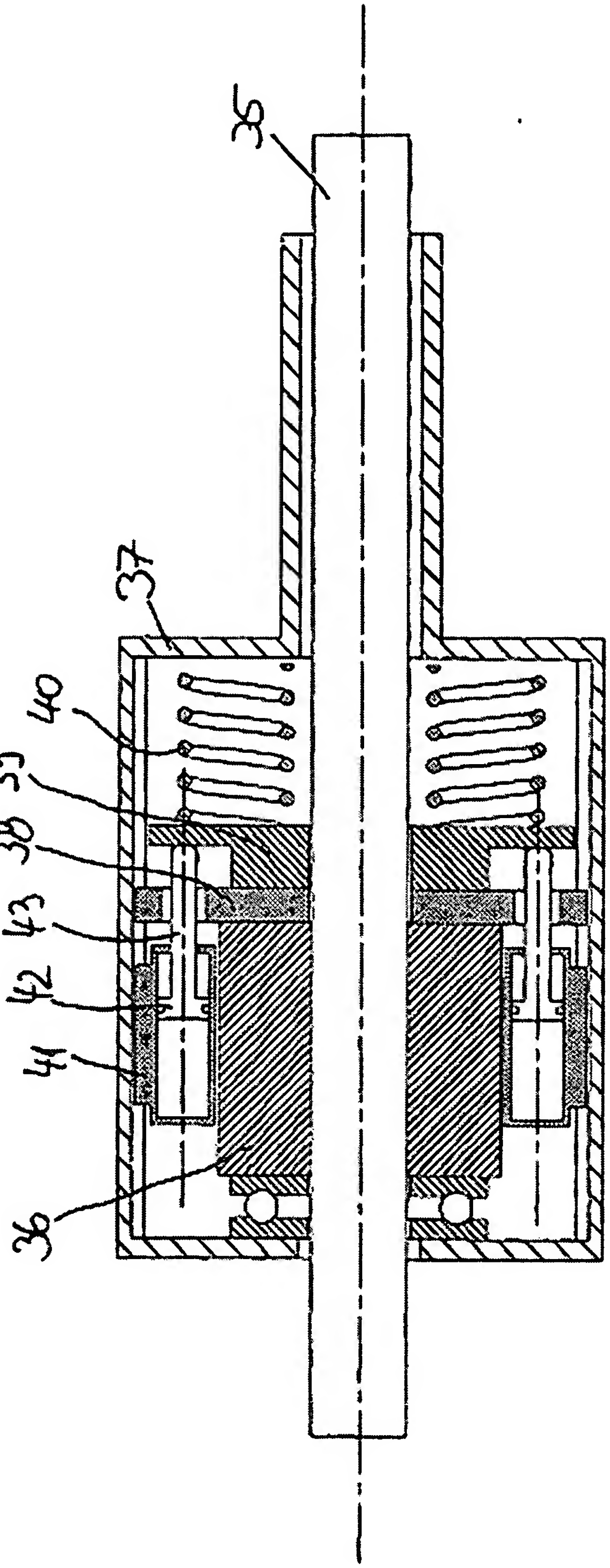


Fig. 5

Fig. 6



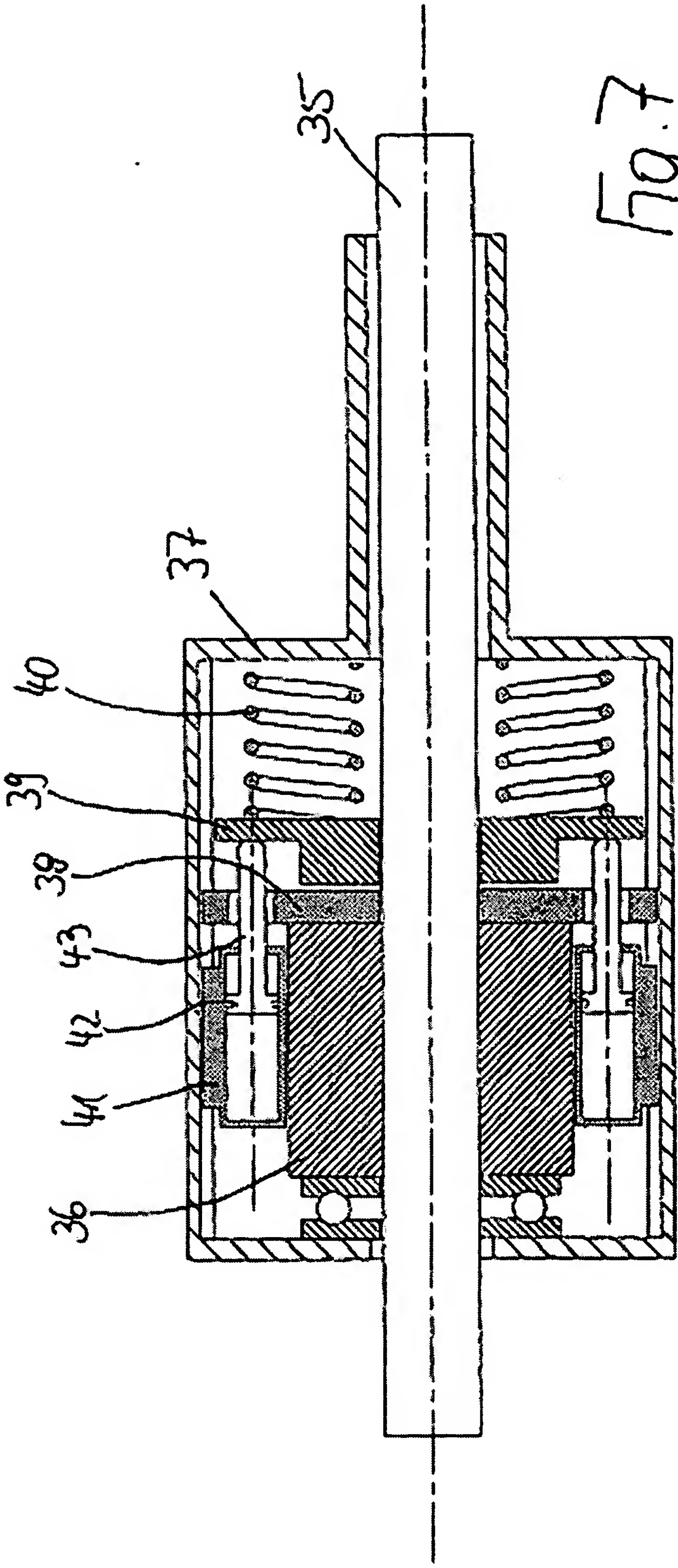


Fig. 7

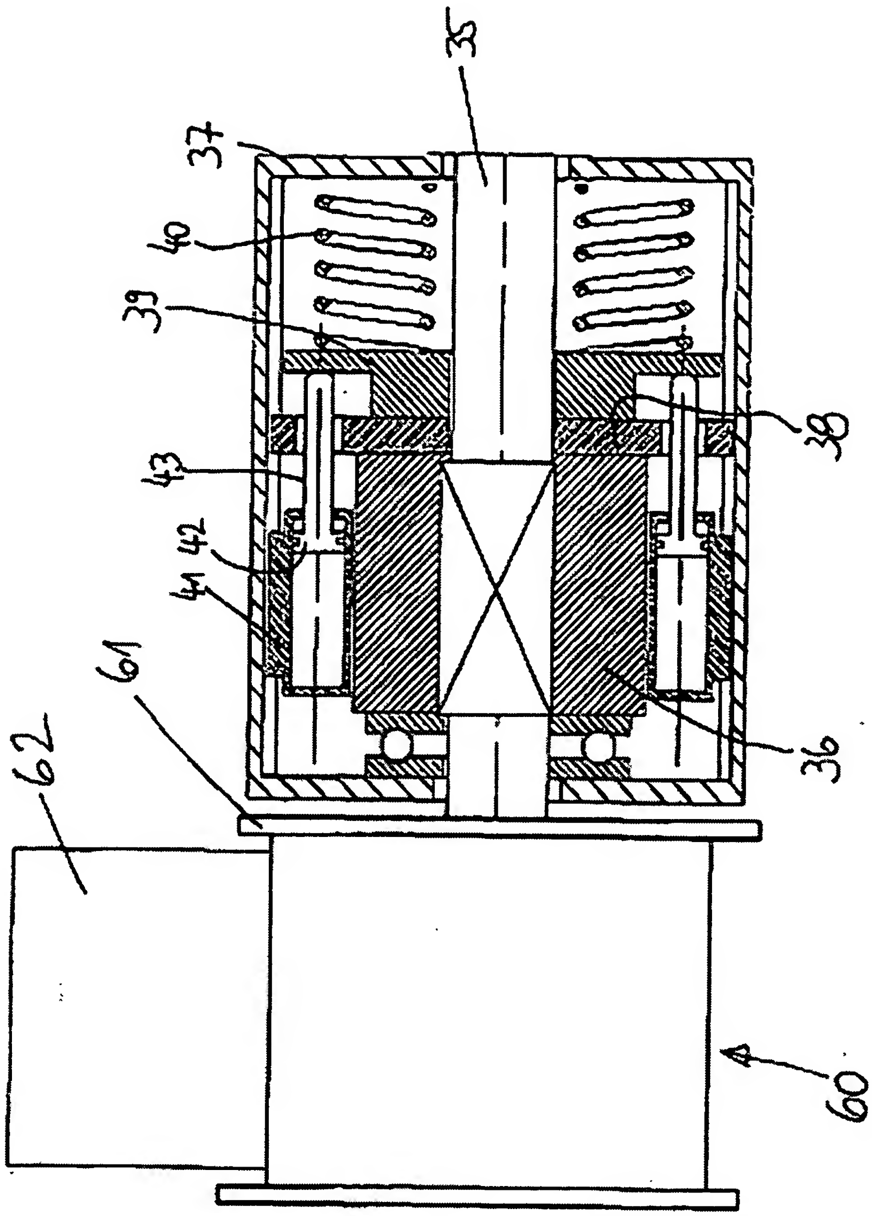


Fig. 8